



Acute Pancreatitis During the SARS-CoV-2 Pandemic: From aetiology to outcome

Akutni pankreatitis med SARS-CoV 2 pandemijo: od etiologije do izida

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Ključne besede: akutni pankreatitis, etiologija, COVID-19 pandemija, zapleti, smrtnost

ABSTRACT

Background: The COVID-19 pandemic disrupted healthcare systems and delayed access to medical care. Its impact on the aetiology, clinical course, and outcomes of acute pancreatitis remains unclear.

Aim: To evaluate the impact of the COVID-19 pandemic on the ethology, clinical course, complications, and mortality of patients with acute pancreatitis in a tertiary care centre.

Materials and Methods: We conducted a retrospective cohort study including 418 patients with clinically, biochemically, and radiologically confirmed acute pancreatitis treated between January 2020 and December 2024. We stratified the patients into pandemic and non-pandemic periods. We assessed disease severity using the modified Balthazar index. We used chi-square tests and logistic regression for statistical analyses.

IZVLEČEK

Izhodišče: Pandemija COVID-19 je pomembno vplivala na delovanje zdravstvenih sistemov in dostopnost zdravstvene oskrbe. Njen vpliv na etiologijo, klinični potek in izide akutnega pankreatitisa še ni povsem pojasnjen.

Namen: Oceniti vpliv pandemije COVID-19 na etiologijo, klinični potek, zaplete in umrljivost bolnikov z akutnim pankreatitisom v terciarnem centru.

Material in metode: Izvedli smo retrospektivno kohortno raziskavo, v katero smo vključili 418 bolnikov s klinično, laboratorijsko in slikovno potrjenim akutnim pankreatitisom, zdravljenih med januarjem 2020 in decembrom 2024. Bolnike smo razdelili glede na obdobje obravnave (med pandemijo in izven nje). Stopnjo bolezni smo ocenili z modificiranim Balthazarjevim indeksom. Uporabili smo hi-kvadrat test in logistično regresijo.

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Results: Of 418 patients, 46.7% were treated during the pandemic. Aetiology differed significantly ($p = 0.028$), with a higher proportion of biliary pancreatitis during the pandemic (45.6% vs 31.8%). Lipase levels were significantly higher during the pandemic ($p < 0.001$), while C-reactive protein levels and length of hospital stay did not differ significantly. Walled-off necrosis occurred in 6.5% of patients and was associated with prolonged hospitalisation (mean 25 ± 20 days, $p < 0.001$). Overall, in-hospital mortality was 3.3% and was strongly associated with the number of complications ($p < 0.001$).

Conclusions: The pandemic was associated with a shift toward biliary aetiology and higher enzyme levels, likely reflecting delayed presentation. However, mortality and length of hospital stay did not change. The number of complications was the main predictor of in-hospital mortality.

Rezultati: Med 418 bolniki jih je bilo 46,7 % obravnavanih med pandemijo. Etiološka porazdelitev se je značilno razlikovala ($p = 0,028$), pri čemer je bil med pandemijo večji delež biliarnega pankreatitisa (45,6 % proti 31,8 %). Vrednosti lipaze so bile med pandemijo značilno višje ($p < 0,001$), medtem ko vrednosti C-reaktivnega proteina in dolžina hospitalizacije niso pokazale značilnih razlik. Omejena nekroza je bila prisotna pri 6,5 % bolnikov in je bila povezana z daljšo hospitalizacijo (povprečno 25 ± 20 dni; $p < 0,001$). Skupna bolnišnična umrljivost je znašala 3,3 % in je bila značilno povezana s številom zapletov ($p < 0,001$).

Zaključek: V času pandemije je prišlo do premika v smeri biliarne etiologije ter višjih vrednosti encimov, kar verjetno odraža zakasnel prihod bolnikov. Umrljivost in dolžina hospitalizacije se nista spremenili. Ključni napovedni dejavnik bolnišnične umrljivosti je bilo število zapletov.

INTRODUCTION

Acute pancreatitis (AP) is an acute inflammation of the gland caused by premature activation of pancreatic enzymes and subsequent tissue autolysis. It is one of the most common acute gastroenterological indications for hospitalisation, with an incidence of 15–80 cases per 100,000 population per year in developed countries. The most common etiological factors are gallstones and alcohol-related damage to the gland, followed by rarer causes such as hypertriglyceridemia, medications, ERCP, and idiopathic cases. The clinical course is highly variable—most patients present with a mild form and have a favourable outcome. Still, approximately 20% of patients develop a severe form with necrosis of the gland, infection, systemic inflammatory response, and multiple organ failure. Mortality in these forms still reaches 15–30% despite advances in diagnostics, modern imaging, early therapeutic procedures, treatment in specialised units, and intensive support (1, 2).

The COVID-19 pandemic caused by SARS-CoV-2 has strained healthcare systems globally and affected the availability and timeliness of emergency and non-emergency medical care. Studies have confirmed increased delays in seeking medical help for acute cardiovascular and surgical diseases, contributing to a higher incidence of complications and poorer outcomes (3). In AP, SARS-CoV-2 may also directly affect the pancreas, as ACE2 receptors, which enable viral entry into cells, are expressed by pancreatic acinar and ductal cells. The literature reports cases of pancreatitis in COVID-19 patients without other known etiological factors (4). Nevertheless, data on the impact of the pandemic on the course and outcomes of treatment of patients with AP remain limited and often contradictory. In a study conducted at the tertiary care department, we compared outcomes among patients with AP during and after the COVID-19 pandemic to assess the pandemic's impact on aetiology, complication rates, treatment success, and mortality. Based on the findings, we sought to identify potential organisational improvements for future similar crises.

The purpose of the study was therefore to obtain data on:

- the frequency and aetiology of AP during and after the COVID-19 pandemic;
- the effectiveness of treatment and mortality among patients with AP during and after the pandemic;
- and the frequency of possible complications and the need for additional treatment in patients with AP in the compared periods.

MATERIALS AND METHODS

In a retrospective, cohort, uncontrolled study, we included patients with clinical and laboratory signs based on which the diagnosis of AP was made, and who were treated at the Gastroenterology Department of the Division of Internal Medicine at the University Medical Centre Maribor in the period from January 1, 2020, to December 31, 2024. We confirmed the diagnosis and aetiology using anamnesis, characteristic clinical presentation, elevated (>3-fold) laboratory markers of pancreatic inflammation (amylase/lipase), and imaging findings. To clarify the aetiology and assess potential complications, we performed chest X-rays to exclude pleural effusion and abdominal ultrasound (US) to evaluate abdominal organs in patients already at the emergency department. When the US was unclear because of intestinal gas or other factors, we performed a contrast-enhanced computed tomography (CT) scan on admission or, as a rule, 2–5 days later, and, in more severe cases, a follow-up contrast-enhanced CT scan during hospitalisation. Abdominal radiologists assessed the degree of morphological change in the gland using a modified Balthazar scale, which evaluates changes according to the following criteria: CT index 0–3 points: mild AP, 4–6 points: moderately severe AP, 7–10 points: severe AP. In cases of suspected choledocholithiasis, we also performed endoscopic ultrasound (EUS) or magnetic resonance cholangiopancreatography (MRCP). Endoscopic retrograde cholangiopancreatography (ERCP) with papillotomy was performed no later than 72 hours after confirmation of chole-

docholithiasis, usually within the first 48 hours (5). We obtained all data necessary for analysis from the UKC Maribor medical database.

We collected the data in an Excel spreadsheet, and entered demographic data, habits, number of comorbidities, laboratory test results, number of complications, length of hospitalisation, mortality, and COVID-19 period. The Ethics Committee of the University Medical Centre Maribor approved the study (Decision No. UKC-MB-KME67/24).

We used JASP (version 0.95.4) on a personal computer running Windows 11 for statistical data processing. We presented nominal variables as numbers and frequencies (%) and numerical variables as mean values and standard deviations.

For numerical variables, we first calculated descriptive statistics and checked distribution normality using the Shapiro-Wilk test. Because most numerical variables were not normally distributed, we used non-parametric statistical methods in subsequent analyses.

To analyse the relationship between two nominal variables, we used the chi-square test after first verifying that the conditions for its use were met (i.e., $\geq 80\%$ of cells with an expected frequency ≥ 5). We analysed the relationship between two numerical variables using Spearman's rank correlation test. For numerical-nominal relationships, we used the Mann-Whitney U test or the Kruskal-Wallis test, depending on the number of groups.

We analysed the relationships between nominal and ordinal variables using cross-tabulation tables and reported the results as p-values. We set the significance level at $p < 0.05$. We used logistic regression analysis to assess the impact of selected factors on hospital mortality. We included the effects of the period, comorbidities, and complications on in-hospital mortality. To improve comparability of extreme values, we presented odds ratios (ORs) in a Forest plot on a logarithmic scale with 95% confidence intervals (CIs). The line at $\log(\text{OR}) = 0$ corresponds to $\text{OR} = 1$ and indicates no effect.

RESULTS

During this period, the GI department treated 418 patients with acute pancreatitis. Of these, 223 (53.3%) were diagnosed outside of the COVID-19 period, while 195 (46.7%) were diagnosed inside the COVID-19 period. Outside COVID-19, patients had an average age of 61 years ($SD \pm 16$ years), ranging from 21 to 95 years. During COVID-19, the average age was 61 ($SD \pm 16$), ranging from 21 to 99 years. During the entire observation period, there were 250 men (59.8%) and 168 women (40.2%). Outside of the COVID period, the sex ratio was 142 men (63.7%) to 81 women (36.3%). During the COVID-19 period, the ratio was 108 men (55.4%) to 87 women (44.6%) (Figure 1).

During the COVID-19 pandemic, the average length of hospitalisation was 11.5 days ($SD = 12$), compared with 12 days outside the pandemic. We used Spearman's rank correlation test and found a weak positive association ($\rho = 0.120$; $p = 0.014$) between patients' ages at diagnosis and hospitalisation duration. The COVID-19 period did not significantly affect hospitalisation time ($p = 0.212$) or age at diagnosis ($p = 0.823$).

From the top three most common causes for acute pancreatitis at diagnosis, the most common, per ICD-10 classification based on data from the entire

research period, were gallstones. This aetiology affected 160 patients (38.3%). Idiopathic acute pancreatitis accounted for the second-highest percentage, affecting 119 patients (28.5%), whereas other types of acute pancreatitis ranked third, affecting 75 patients (17.9%). Outside the COVID-19 period, the most common aetiology was undefined acute pancreatitis in 77 patients (34.5%), followed by acute biliary pancreatitis in 71 cases (31.8%) and other types of acute pancreatitis in 40 cases (17.9%).

During the COVID-19 period, acute biliary pancreatitis was the most common aetiology in 89 cases (45.6%), followed by unspecified acute pancreatitis in 42 cases (21.5%) and other acute pancreatitis subtypes in 35 cases (17.9%). We analysed the association between disease aetiology and the COVID-19 period using the chi-square test of independence. We found a statistically significant association ($\chi^2 = 12.53$; $p = 0.028$). The effect size was weak (Cramér's $V = 0.173$). Of all the risk factors included, alcohol consumption was the most common among patients throughout the observation period, occurring in 73 patients (17.5%), closely followed by smoking in 69 patients (16.5%). Drug use was almost absent, occurring in 3 patients (0.7%) (Figure 2).

The study aimed to investigate comorbidity in patients with acute pancreatitis. We classified patients into three categories by number of comorbidities: class I (0 comorbidities), class II (1–3 comorbidities), and class III (> 3 comorbidities). Outside the COVID-19 period, 39 patients (17.5%) fell into the I class, 145 patients (65%) into II class and 39 (17.5%) into III class. During the COVID-19 outbreak, 24 patients (12.3%) classified into I class, 138 patients (70.8%) were classified into II class and 33 patients (16.9%) into III class. The association between the number of comorbidities and the period was not statistically significant ($p = 0.304$), with a very weak correlation (Cramer's $V = 0.075$). (Figure 3).

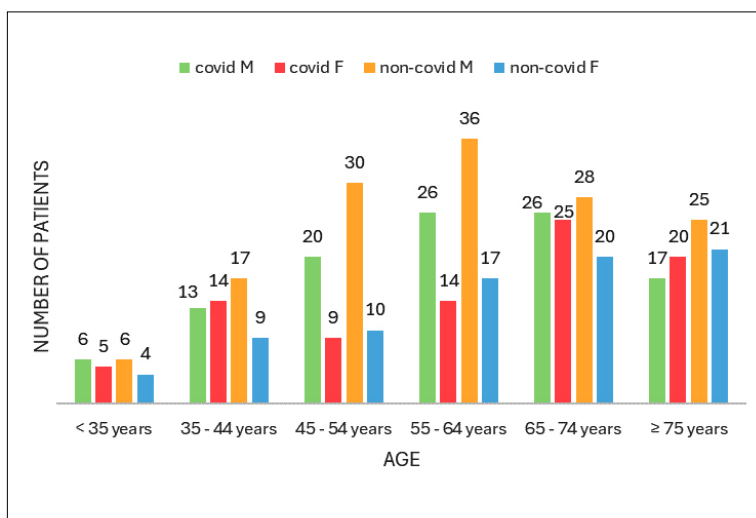


Figure 1: Demographic characteristics of patients with AP, by gender and age distribution.

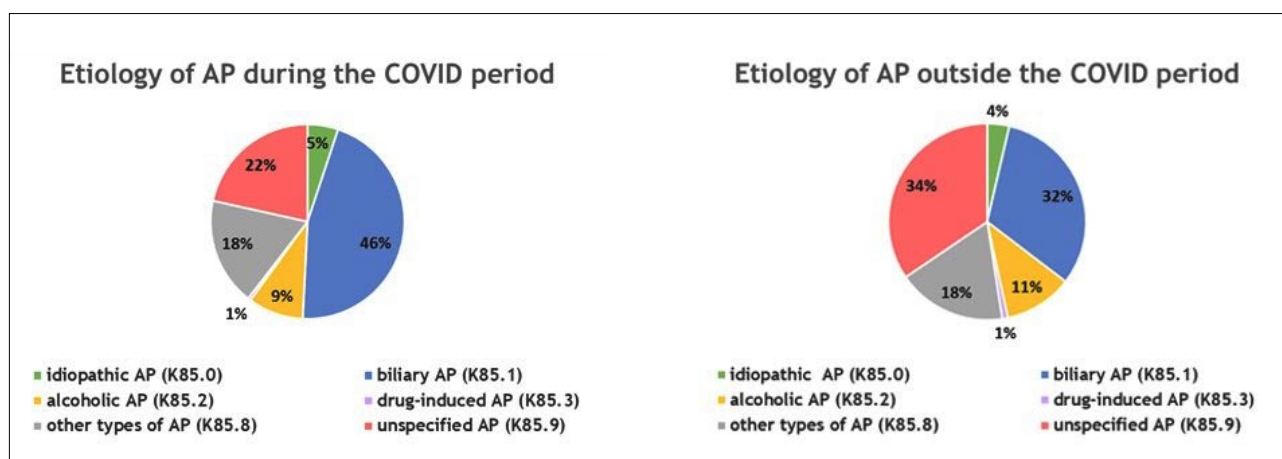


Figure 2: Comparison of the aetiology of AP during and after the COVID-19 pandemic.

Similarly, we monitored complication incidence and classified patients into three categories. Class I (0 complications), class II (1–3 complications), and class III (> 3 complications). Outside the COVID-19 period, 108 patients (48.4%) classified into I class, 85 patients (38.1%) were classified into II class, and 30 patients (13.5%) into III class. During the COVID-19 period, 111 patients (57%) classified into I class, 66 patients (33.8%) into II class, and 18 patients (9.2%) into III class. Among all patients, 27 developed walled-off necrosis (WON), representing 6.46% of the cohort. These patients had a statistically significantly longer average length of hospitalisation ($p < 0.001$). The length of hospitalisation was more than twice as long, with a mean of 25 days ($SD \pm 20$ days). Of the 27 patients who developed WON, 4 (14.8%) were COVID-19 positive. The distribution of complications did not differ significantly

between the two periods ($p = 0.168$), with a very weak association (Cramer's $V = 0.092$). (Figure 4).

For laboratory tests, we closely monitored CRP, calcium, and lipase levels. The CRP level peaked on the third day after diagnosis, with a mean of 172.8 mg/L ($SD \pm 121.1$ mg/L). The two periods did not differ significantly. The Mann-Whitney U test revealed no statistically significant difference between the two periods ($p = 0.077$). Lipase levels differed significantly between periods, with higher values more indicative of acute pancreatitis: the average outside the COVID-19 period was 151.3 μ kat/L ($SD \pm 236.7$ μ kat/L), whereas during the COVID-19 period the average was 227.1 μ kat/L ($SD \pm 281.9$ μ kat/L). The Mann-Whitney U test showed a statistically significant association between period and change in lipase ($p < 0.001$).

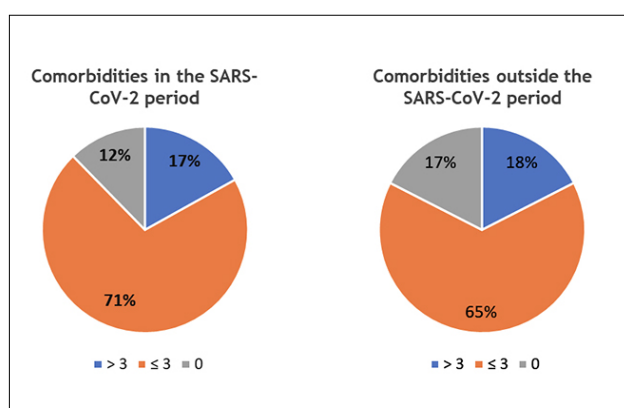


Figure 3: Comparison of comorbidities associated with AP during and after the COVID-19.

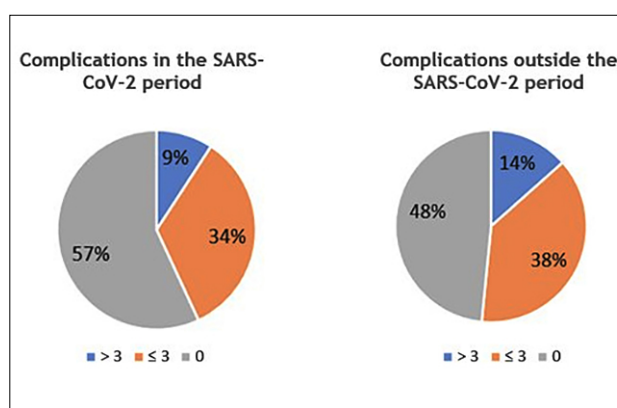


Figure 4: Comparison of complications of AP during and after the COVID-19 pandemic.

As a result of the disease, 14 patients (3.3%) died in hospital, 8 patients (4.1%) during the COVID-19 period, and 6 patients (2.7%) outside the COVID-19 period. Using the chi-square test, we found that hospital mortality was not significantly associated with the COVID-19 period ($\chi^2 = 0.641$, $p = 0.423$), with a very weak association (Cramer's $V = 0.039$). Similarly, there was no statistically significant association between the number of comorbidities and the period ($\chi^2 = 3.718$, $p = 0.156$), with a very weak association (Cramer's $V = 0.094$). However, the number of complications was significantly associated with hospital mortality ($\chi^2 = 24.56$, $p < 0.001$), with a weak correlation (Cramer's $V = 0.242$). We then used a logistic regression to determine the effects of the period, comorbidities, and complications on in-hospital mortality. Logistic regression showed that only complications statistically significantly affected in-hospital mortality ($p < 0.001$; Nagelkerke $R^2 = 0.218$). Patients with 1-3 complications were 9.2 times more likely to die than those without complications ($p = 0.041$), while patients with multiple complications were more than 40 times more likely to die ($p < 0.001$). Forest plot shows OR values on a logarithmic scale with 95% confidence intervals (CI) for better comparability of extreme values.

The line at $\log(OR) = 0$ corresponds to $OR = 1$, indicating no effect (Figure 5).

DISCUSSION

Acute pancreatitis is a serious medical condition that can cause both local and systemic complications and, in the event of complications, is associated with a high mortality rate. The incidence varies by geographic region, often reflecting differences in lifestyle, dietary habits, and specific triggers.

In our study, the epidemiological profile was consistent with the existing literature, with a predominance of males (60%) and a higher incidence in older age groups (> 40 years) (1, 2). The length of hospitalisation did not change significantly between the two periods. The lack of change in hospitalisation length and the statistical insignificance of associations between period and length of hospitalisation, and between age at diagnosis and length of hospitalisation, indicate stable healthcare quality even during the COVID19 pandemic. This contrasts with studies reporting prolonged hospitalisation and limited availability of certain therapeutic procedures due to overcrowding in COVID-19 wards. In our country, the flexibility of healthcare structures and protocols, along with selective patient inclusion, likely played a key role in maintaining quality care even during crises (6, 7).

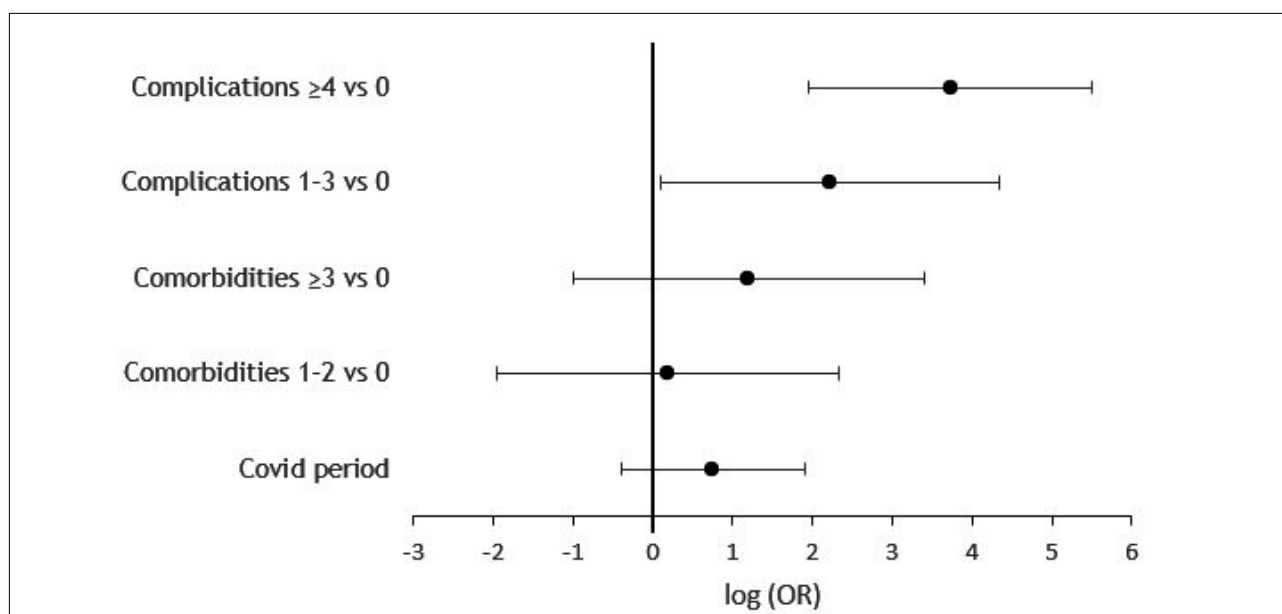


Figure 5: The impact of the specified factors on in-hospital mortality.

According to global literature, the two most important factors for the development of the disease are gallstones and alcohol consumption. Less common causes include metabolic disorders (e.g., elevated blood lipid or calcium levels), parotid gland disorders, viral infections (e.g., Coxsackie, Epstein-Barr, cytomegalovirus, mumps virus), abdominal injuries, and side effects of certain medications. In approximately 10% of patients, the cause cannot be precisely determined; these cases are classified as idiopathic, autoimmune, or hereditary/genetically determined (1, 2, 5, 8, 9, 10).

Determining the aetiology and complications of AP can sometimes be very challenging. In addition to laboratory tests, we use modern imaging modalities such as ultrasound, contrast-enhanced CT, endoscopic ultrasound, and MRCP to clarify the causes, assess the extent of damage to the gland and its immediate surroundings, and evaluate the systemic inflammatory response. In addition to imaging, interleukins and inflammatory markers (IL-6, IL-8, IL-10) provide additional diagnostic support. Both diagnostic procedures are most effective when performed and followed up within 72 hours (5, 10). For detecting choledocholithiasis in AP, abdominal ultrasound has a sensitivity of 50–80% and a specificity of about 90%. The diameter of the common bile duct is an essential additional diagnostic parameter: at a diameter ≤ 3 , the presence of stones is unlikely; at > 4 mm, the possibility increases, and at ≥ 9 mm, choledocholithiasis is very likely (5). EUS is the imaging method best suited to confirm choledocholithiasis with sensitivity and specificity generally exceeding 90% (5). CT plays a central role in cases of suspected necrotising AP. Contrast-enhanced CT (CECT) is essential; however, it often fails to reveal necrotic changes in the early stages. MRCP allows non-invasive imaging of the biliary and pancreatic ducts and is frequently used to exclude choledocholithiasis when cholangitis is absent. Unlike US, which is more sensitive for small stones (< 5 mm), MRCP is non-invasive and less dependent on the examiner's experience.

At present, ERCP is primarily a therapeutic method for diagnosed choledocholithiasis. Current guidelines recommend urgent ERCP in patients with confirmed choledocholithiasis and associated cholangitis, as it enables stone removal from the bile ducts and, if necessary, stent placement. In patients without signs of infection, ERCP is postponed until the inflammation subsides. Early papillotomy, within the first 72 hours of diagnosed choledocholithiasis has been shown to result in a milder course of AP (5).

In Slovenia, emergency ERCP is performed daily, with weekend procedures carried out by interventional endoscopists at the University Department of Gastroenterology at the University Medical Centre Ljubljana. ERCP may also be associated with the development of so-called 'post-ERCP' pancreatitis, which remains the most common complication of the procedure (5, 8, 9, 10, 11, 12, 13).

In our analysis, we observed a significant change in the etiological distribution of AP: biliary pancreatitis predominated during the pandemic, whereas in the post-pandemic period, undefined (idiopathic) pancreatitis was the most common.

In the post-pandemic period, we have observed an increase in reports of AP aetiologies characterised by biliary tract thickening without evident bile obstruction. A possible, and most likely, reason for this is delayed diagnostic evaluation, as the triggering factor in the form of dietary indiscretion, alcohol abuse, or 'memory gaps' in patients may be outdated. Undefined pancreatitis thus encompasses all pancreatitis that cannot be classified with certainty into any of the other etiological groups, even though biliary aetiology may be responsible. This change is relevant and is partly consistent with the findings of Kumar et al. (2021), who also reported a change in the etiological structure due to changes in access to diagnostics and therapy during the pandemic (3). It should be noted that the increase in cases of biliary pancreatitis may also be attributable to delays in elective cholecystectomies and limited access to

primary health care, leading to worsening biliary diseases and a higher incidence of pancreatitis complications (7). We examined how comorbidities affected the course of AP. In both periods, most patients had one to three comorbidities, consistent with our sample's demographic profile, which was predominantly aged over 40 years (1, 2). Statistical analysis showed no statistically significant association between the period and the number of comorbidities. As with complications, according to the MEDIS information system, 95% of patients with AP treated at the University Medical Centre Maribor were managed in the Department of Gastroenterology. In light of this, the sample is representative, and the proportion of patients at risk due to multiple comorbidities and therefore treated in intensive care units is negligible. As with comorbidities, we divided patients with complications into groups; unlike comorbidities, the largest proportion was patients without complications, which is expected, as complications indicate a more severe disease course.

Although we did not find a statistically significant difference in the incidence of complications between the two periods studied, there was a trend toward a slightly lower incidence during the pandemic. This finding needs to be explained in the context of the organisation of treatment, as, as mentioned above, only patients treated in a specialised gastroenterology department were included in our study, where, according to the MEDIS information system, more than 95% of patients with AP are treated at the Division of Internal Medicine at a tertiary institution. Patients with more severe disease who developed complex or life-threatening complications were transferred to internal intensive care or an infectious disease department if they were also COVID-19 positive.

This selection of patients, given that a proportion of patients likely avoided hospitalisation (7), may have contributed to the lower incidence of complications observed in our sample, as patients with more severe disease treated in intensive care units

were excluded from this analysis. This fact is important to consider when interpreting the results, as it may contribute to the apparent lower incidence of complications in the gastroenterology department, whereas more serious complications are recorded elsewhere. Patients with WON complications had a hospitalisation length more than twice as long, at 25 ± 20 days.

A similarly prolonged treatment is also described in the literature: in a retrospective cohort study of patients with large WONs, the authors reported a median hospitalisation duration of 53 days (14). Such discrepancies likely reflect transfers to the intensive care unit, which formally reduced hospitalisation duration because patients were physically present in the intensive care unit, where hospitalisation days are documented separately. For this reason, the actual burden and duration of treatment in patients with WON are likely to be underestimated if only conventional hospital care in the Department of Gastroenterology is considered. In any case, data on patients with WON who require numerous interventional procedures by radiologists and interventional endoscopists, including the insertion of Lumen-Apposing Metal Stents (LAMS) and the removal of necrotic tissue from abdominal cavities, reflect the significant clinical and organisational impact of these complications. The analysis confirms that WON strongly predicts a prolonged, complicated course and more complex treatment. Because of the limited sample size and retrospective design, we cannot reliably assess whether COVID-19 infection directly increases the risk of developing WON. Our analysis and conclusions align with the international literature, which describes cases of pancreatitis with WON complications in COVID-19 primarily as individual cases, without systematic evidence of increased incidence.

CRP values did not differ significantly between the two periods, suggesting that the inflammatory response in AP may not have been directly affected by pandemic conditions but instead reflects individual disease severity (15, 16).

In contrast, average lipase levels during the COVID-19 period were significantly elevated, suggesting more pronounced acute inflammation. A more likely explanation is delayed presentation to healthcare facilities. The literature well documents the link between higher pancreatic enzyme levels and more severe forms of AP (Cho et al., 2023; 16). Our findings align with international literature reporting that the COVID-19 pandemic contributed to delays in seeking medical care, increasing the risk of more serious complications and worsening clinical outcomes (6, 7, 17).

Despite expectations, more advanced logistic regression analysis did not reveal a statistical association between the number of comorbidities and mortality. This result may be because patients with multiple comorbidities and more severe clinical courses are often treated in the intensive care unit or infectious disease department and were therefore not included in our gastroenterology sample. The prevailing view in the literature is that comorbidities contribute to poorer outcomes, particularly with concomitant SARS-CoV-2 infection (18, 19, 20). However, we found that the number of complications was the leading predictor of in-hospital mortality, consistent with prior studies (21, 22).

References

- Wang CF, Tariq A, Chandra S. Acute Pancreatitis. StatPearls [Internet]. 2025. [cited 2026 Feb 23]. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK482468/>
- Skok P, Čeranić D, Krajnc Genslitskaya E. Acute pancreatitis - results of a prospective study. *Zdravniški Vestnik*. 2008; 77(9):573-578.
- Kumar V, Barkoudah E, Souza DAT, et al. Clinical course and outcome among patients with acute pancreatitis and COVID-19. *European Journal of Gastroenterology & Hepatology*. 2021;33(5):695-700.
- Liu F, Long X, Zhang B, et al. ACE2 Expression in Pancreas May Cause Pancreatic Damage After SARS-CoV-2 Infection. *Clinical Gastroenterology and Hepatology*. 2020;18(9):2128-2130.e2.
- Čeranić D, Skok P, Zorman M. The role of endoscopic ultrasound and anti-inflammatory cytokines in explaining the aetiology and course of acute pancreatitis. Doctoral dissertation. Faculty of Medicine, University of Ljubljana, 2019.
- Ramsey ML, Patel A, Sobotka LA, et al. Hospital Trends of Acute Pancreatitis During the Coronavirus Disease 2019 Pandemic. *Pancreas*. 2022;51(5):422-426.
- Türkylmaz Z, Demirel T, Çakcak İE, et al. What has changed? The impact of the COVID-19 pandemic on the management of acute biliary pancreatitis. *Ulusal Travma ve Acil Cerrahi Dergisi*. 2023;29(10):1167-1174.
- Thiruvengadam M, Gajendran M, Thiruvengadam S, et al. Acute Pancreatitis. *Disease-a Month*. 2012;58:98-144.
- Trikudanathan G, Yazici C, Phillips AE, et al. Diagnosis and Management of Acute Pancreatitis. *Gastroenterology*. 2024;167(4):673-688.
- Tenner S, Vege SS, Sheth S, et al. American College of Gastroenterology guidelines: Management of Acute Pancreatitis. *American Journal of Gastroenterology*. 2024;119:419-437.
- Clancy TE, Benoit EP, Ashley SW. Current Management of Acute Pancreatitis. *Journal of Gastrointestinal Surgery*. 2005;9(3):440-452.
- Strang D, Law RJ, Yang D, et al. AGA Clinical Practice Update on the Endoscopic Approach to Recurrent Acute and Chronic Pancreatitis: Expert Review. *Gastroenterology*. 2022;163(4):1107-1114.
- Dajčman D, Skalicky M, Tošovič Z. Comparison of modern diagnostic methods for gallstones in the common bile duct and guidelines for their stepwise use. *Zdravniški Vestnik*. 2004;73(4):191-5.
- Ebrahim M, Werge MP, Hadi A, et al. Clinical outcomes following endoscopic or video- assisted retroperitoneal management of acute pancreatitis with large (>15 cm) walled-off pancreatic necrosis: retrospective, single tertiary centre cohort study. *Digestive Endoscopy*. 2022;34(6):1245-1252.
- Stirling AD, Moran NR, Kelly ME, et al. The predictive value of C-reactive protein (CRP) in acute pancreatitis - is interval change in CRP an additional indicator of severity? *HPB (Oxford)*. 2017;19(10):874-880.
- Cho IR, Do MY, Han SY, et al. Comparison of Interleukin-6, C-Reactive Protein, Procalcitonin, and the Computed Tomography Severity Index for Early Prediction of Severity of Acute Pancreatitis. *Gut and Liver*. 2022;17(4):629-637.
- Rădulescu PM, Căluianu EI, Trașcă ET, et al. The Impact of the COVID-19 Pandemic on Outcomes in Acute Pancreatitis: A Propensity Score Matched Study Comparing before and during the Pandemic. *Diagnostics (Basel)*. 2023;13(14):2446.
- Singh AK, Gillies CL, Singh R, et al. Prevalence of comorbidities and their association with mortality in patients with COVID-19: A systematic review and meta-analysis. *Diabetes, Obesity Metabolism*. 2020;22(10):1915-1924.
- Hua S, Yang Y, Zou D, et al. COVID-19 and metabolic comorbidities: An update on emerging evidence for optimal therapies. *Biomedicine & Pharmacotherapy*. 2021;140:111685.
- Hidalgo NJ, Pando E, Mata R, et al. Impact of comorbidities on hospital mortality in patients with acute pancreatitis: a population-based study of 110,021 patients. *BMC Gastroenterology*. 2023;23(1):81.
- Selin D, Maret-Ouda J, Oskarsson V, et al. Long-Term Mortality in Acute Pancreatitis-A Population-Based Cohort Study. *United European Gastroenterology Journal*. 2025;13(4):640-649.
- Yu L, Xie F, Luo L, et al. Clinical characteristics and risk factors of organ failure and death in necrotising pancreatitis. *BMC Gastroenterology*. 2023.